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SOME NEW METHODS OF TEST MEAL AND FECES EXAMINATIONS. THEIR SIGNIFICANCE IN CLINICAL WORK.*

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THERE is no always and no never in medicine—and so it is with test meal and feces examinations in diagnosing gastroenteric affections. Therefore, it is manifest that any means which can bring into easy clinical utilization some of the additional and more difficult (and thus rarely employed) points in laboratory procedure, seems worthy of consideration. Particularly is this true, when, by test meal analyses the states of acid-enzymotic secretion, presence of blood, certain bacteria, food, tissue particles and so forth from the stomach give negative findings in the majority of cases of gastric ulcer and early cancer; when, the other than test meal methods of examination have proven worthless in the diagnosis of hyperacidity and hypersecretion of the stomach; when, considering the digestive tract as a whole, the dietetic tests observed from feces examinations so often lead one astray; and when, the states of chronic intestinal putrefactions are more times mat-

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ters of speculative assumptions rather than accurate clinical diagnoses.

Without wishing to rock the pedestals of belief, teaching and division of internal medicine upon which golden gods have rested, it is nevertheless true that clinical observation has shown that much has been advanced in a too definite way, or to have been accepted with but too scant or too theoretical a basis, or to have been passed by with a but too hurried attention.

Among some of these may be mentioned the following: More cases of gastric ulcer exist without hyperacidity than with it.[1] Gastric bleeding is a common finding in acute ulcers during the first days, and, when unhealed, rare after that. Vomiting (the cardinal symptom of severe stomach disease), boring pain (in contrast to simple distress of a hyperæsthetic type which is so common in most other stomach and in many extra gastric affections), and intolerant stomach to foods, all, as symptoms, are seen present in but 25 per cent. of the cases of gastric ulcer, considering all of the twelve forms of ulcer pathologically seen.[2] Cancer, diagnosed early enough for hope of cure by surgery, presents no subjective and often no definite objective symptoms. Collective vomiting of stagnant fermenting foods and achylic fluids containing Boas-Oppler bacilli, lactic acid and blood usually means a mass in the epigastrium, emaciation, cachexia and anæmia and a case too late for hope of cure. Early cancer generally displays a normal or even a hyperacid stomach, and it is shown that in but very few of the early cases does the test meal

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[1] Graham and Guthrie. *New York Medical Journal,* September 4, 1909.

[2] Bassler. *Archives of Diagnosis,* October, 1909.

throw any light upon the real pathology present. It will thus be seen that in these two most important of all stomach conditions (ulcer and cancer), the ordinary gastric analyses may have to be looked upon as suggestive in negative findings, and who among us has the deductive ability or courage of diagnosing ulcer or cancer in that way. The fibrin strings of the Günzburg and Sahli packages in a patient with a anachlorydric stomach can be disintegrated in the intestines in short enough time to lead one astray in diagnosing the condition of stomach secretion. The connective tissue test of Schmidt in diagnosing states of gastric secretion is likewisely found to be worthless in clinical work. In the dog, at least one-third of the connective tissue of meat is delivered into the intestine, and who ever found connective tissue in the feces of that animal? Dietetic methods, such as the Schmidt diets, and particles of food attached to undigestible substances, such as Einhorn bead method, are also liable to be fallaceous. Assuming, for instance, that there are present in the bowel large amounts of proteid splitting bacteria, such as are seen in the indolic type of chronic intestinal putrefaction, or large amounts of the carbohydrate bacteria fermentors, such as are observed in the saccharo-butyric type of chronic putrefaction, what happens to the proteid or carbohydrate diet tests and food attachments to the beads—they are disintegrated and the examination of the feces shows good digestion instead of a most seriously disturbed one. Do all cases of indolic putrefaction show large amounts of indican in the urine? No. The bowels may be loose and the food-bacteria products of putrefaction come away before resorption, or the oxydase

in the liver or kidneys may for a time bind it before it can be eliminated and thus the indican, uroresine, or even oxalic acid crystals may not be seen in significant amounts.

The points in examinations of test meals and feces I speak of to-day have at various times been advanced by others and neglected or not utilized. All I offer to you is a modest and simple means making possible the clinical utilization of these matters and some deductions of my own from over five years of work with them, covering nearly 11,000 observations with the tests. You are not to understand that testing test meals and feces by means of bacteria are to supplant the generally employed methods of analyses for observing secretion and motility; but only to be considered as additional methods in the hope of making possible diagnoses of some of the difficult to discover gastroenteric affections.

The tests are made by means of an especially constructed fermentation tube,[1] the upright, closed or anærobic limb of which has a 15 c.c. capacity and graduated in per cents, and an open bulb of 30 c.c. capacity. The apparatus over all is less than 6 inches in height, will go into a medium-sized incubator, and is constructed so that 25 c.c. sufficiently fills the instrument; and 25 c.c. is an amount that usually can be taken from the return of an Ewald meal and still leave enough for the secretory and motor observations. Into it is placed a portion of the return of a simple or mixed test meal in which the free HCl has been neutralized with a normal solution of sodium hydrate, using dimethyl sol. as an indicator; or for the chemical test of feces 7.5 grams of the soft end of a stool (mushy consistence)

[1] Bassler. *New York Medical Journal*, September 18, 1909.

or 10 c.c. of a more liquid stool, each of which are mixed in 25 c.c. of sterile water; in the bacteriological tests with media, the tube is filled with a 2 per cent. dextrose-bouillon and inoculated with about 1 c.c. of the test meal, or three or four drops of a watery suspension of feces or a little less amount of the feces itself. In the case of the chemical tests of the feces, the weighed portion of the stool is thoroughly mixed with water in a casserole by means of a common teaspoonful and any very large sticks of cellulose or vegetable substance removed, more feces being added to make up the shortage. The fermentation tube (a) is then placed in the water jacketed oven, where it remains for twenty-four hours at 37 degrees C., when the examinations are made. If at the time of examination more or less floating feces and incorporated gas are seen at the top of the fluid in the upright limb, several fair-sized shot are placed into the bulb, which is then filled with water, corked so that no air from without is present between the fluid and the cork, and the instrument is shaken so that the shot splits up the floating feces, after which the gases that have escaped into the bulb are passed back into the closed limb, the cork is withdrawn, some of the fluid is run out, and the observations made as follows:

First, the total gas content is observed, after which in the chemical or bacteriological feces tests some of the fluid is withdrawn from the bulb and examined for indol and uroresine, and with the nutritive media also for aerobic bacteria, care being taken that the tube is not shaken and that the one or two drops of media taken be from the film on the surface and at different levels under this but not actually down to the crotch

between the two sides. The next step in the nutritive media test is to obtain samples of the important anærobic bacteria. These are best extracted by means of a pipette (b) which should be carefully introduced into the lower part of the anærobic limb and about 0.5 c.c. of media sucked up. In tests to note the amounts of bacteria growing at different levels of the fluid media in the closed limb I have found that at the end of twenty-four hours most of the anærobic bacteria are at the bottom of the tube, although they also are scattered throughout the closed limb and thus may be obtained from the upper layer of fluid when the cock has been opened. The carbon dioxide in the accumulated gases is now absorbed by introducing into the closed limb with the pipette 2 c.c. of a saturated solution of sodium hydrate (making sodium carbonate) and the tube is inclined to permit this heavy solution to run some distance up into the closed portion and allowing it to stand for the time necessary to observe that the fluid no longer raises in the tube. In a number of tests to note the accuracy of this chemical method, I have observed that the remaining Co_2 is never more than from 5 to 10 per cent. of the original amount, and this is close enough for clinical work. The remaining mixed gases are then tested in the twin bottles, they being driven through when the cock is opened by means of attachment (e) and blowing. The reactions of the gases are noted in the first bottle (c), which contains a weak solution of neutral azolitmin (which is a pure litmus about 200 times as sensitive as commercial litmus), a control in a test tube being used to note the color change. In addition to the reaction of the gases, in the chemical and bacteriological

feces tests the fluid in the apparatus should be tested with litmus at the filling of the apparatus and at the end of the twenty-four hours to note the chemical change. The second bottle (d) contains lead water (sol. plumbic acetate 10 per cent.) to note the presence of sulphurated hydrogen (turns darker or black according to amount present). The hydrogen and marsh gas may be burned at the drawn tube outlet, but as both burn with an indistinguishable blue flame and as neither of these gases are important in the clinical way this may be omitted.

Normal Standards.

It is apparent that all tests must have a normal or negative standard to judge results from. In these tests several thousands test meals from normal or neurotic stomachs shows this to be an easy matter, because it is never seen that test meals from normal stomachs or the neurotic conditions of hyperæsthesia gastrica, gastralgia, hyper- and hypo-motility and even hyper- and low acid-enzymotic secretions ever give more than the merest bubble at the top (which is always less than 1 per cent.), and in hyperacidity and hypersecretion of the dietetic or referred forms that same general rule holds good.

This is due, in my opinion, to the facts that the pylorus is normally patent and the motility is not seriously disturbed (thus the organ empties itself in about the normal time according to the amounts and character of the food present), and the fact that the normal gastric secretion can inhibit the growth of such of the bacteria as that are present, preventing them from excessively fermenting the saccharides. But when we deal with the chemical feces tests (watery suspen-

sions) we enter into an uncertainty and difficulty in making definite standards. The reasons for this are that the amounts of carbon dioxide, hydrogen, nitrogen, sulphurated hydrogen and marsh gas, and even the reactions, vary, depending upon the character and amounts of food, upon the kinds and amounts of bacterial flora present from the ileum down, and the functionating power and pathology of the gastroenteric canal and the accessory organs of digestion.

ESTIMATES OF DIFFERENT GASES OBTAINED FROM FECES IN VARIOUS DIETS IN NORMAL INDIVIDUALS.

Diets.	*Hydrogen.*	*Nitrogen.*	*Carbon Dioxide.*	*Marsh Gas.*
Milk	50%	30%	12%	0.09%
Meat	2%	50%	10%	31%
Vegetables .	3%	37%	37%	50%

Sulphurated hydrogen in small amounts is present in all.

To arrive at some standard of gas result from watery suspension of feces from normal individuals with my method I have made observations of feces from nineteen apparently normal persons, and comparing these with the many tests of feces from abnormal individuals I have come to the following conclusions: The Schmidt and Strassburger test diets (first No. 2 and then No. 1) do not give better results than does the combination of the daily mixed diet that the individual ordinarily uses followed by a strict meat and water and a strict carbohydrate and water diets. For these reasons, I have discontinued the use of the difficult to institute and carry out Schmidt and Strassburger diets and have employed the three separate diet tests instead. The Schmidt diag-

nosis of "fermentative dyspepsia" is a most vague and impractical one for clinical work and means but little to base our therapeutics upon. The gas results from the diets I have suggested may be mentioned from 10 to 30 per cent. for the ordinary mixed diet; less than that, from 5 to 20 per cent., for the meat and water diet; and more than the ordinary diet for the carbohydrate and water diet, namely from 15 to 40 per cent. On a strict meat and water diet it may fall to one-half, and on a strict carbohydrate and water diet it is usually higher. The reaction of the fluid should always remain neutral, never becoming definitely acid or alkaline.

With the use of the nutritive media inoculated with test meals from normal stomachs, up to 5 per cent. may be taken as the normal limit, and when inoculated with feces, from 20 to 30 per cent.; never below or above these figures. With the bacteriological tests, special diets are not important and in fact are not advisable. Other points here are that the reaction of the gases should never become definitely acid or alkaline, or perceptibly large amounts of indol or uroresine be present in the fluid at the end examination.

Clinical Deductions From the Analysis of Test Meals.

Stomach.—Gas generation from test meals depends upon three stomach conditions, the state of acid-enzymotic secretion, the dynamic conditions, and amounts of bacteria according to the gastric conditions, and these to a greater or lesser extent conjointly influence the result according to the gastric conditions present. Sufficient secretion of hydrochloric acid acts as a germicide, and good motility with the pyloric

region patent shortens the time that food remains in the stomach, and thus is also germicidal in the way of emptying the organ. When, however, these are interfered with, the bacteria may proliferate and thus gas may be formed. In ulceration and cancer (which at autopsy is generally found more or less ulcerated on the exposed surface) the stomach functionating conditions may be normal or even above normal, and still the local pathology present cause the generation of large amounts of bacteria, and these may be so abundant that the saccharides of the test meals are fermented by them. The gas results from each case must be figured along these lines. That is, an Ewald meal of 60 c.c. return, of which 10 c.c. of filtrate shows a free HCl. of 30 degrees, a combined HCl. of 30 degrees, and this meal a greater than 2 per cent. of gas result, more significantly points to ulcer or cancer than one of like amount of return and gas result having only half as much HCl. content, although in my experience even the latter would be significant enough.

Acute Gastritis.—The vomitus or a test meal removed during an attack of acute gastritis shows an achylic return with undigested fermenting foods, and, because of the butyric and acetic acids present, gives a gas result perhaps as high as 10 per cent. and also the presence of the volatile acids in the reaction bottle.

Moderate Grades if Chronic Gastritis Low in Acid-Enzymotic Secretion.—Test meals from these states show a low acidity and enzyme secretion, increased mucus and slight food retention, a gas result never above 5 per cent. from the neutralized test meal, and often the volatile acids in the reaction bottle.

Atrophic Gastritis.—The achylic test meals from these cases usually show a larger gas result than 3 per cent., most times neutral in reaction, but may be acid, most of which gas, however, is carbon dioxide from fermentation of the starch of the test meal, the alcohol going into solution in the fluid. True fermentation seen in states of gastritis, versus neurological conditions in which eructations are present, can be differentiated by the presence or absence of gas results in the apparatus.

Gastric Ulcer.—The sero-sanguinous vomitus from acute ulcer often shows as high as 10 per cent. of gas even in the face of a high acid secretion in the stomach. In test meals from acute ulcer cases a higher than 2 per cent. gas may be noted, and this taken in conjunction with a highly acid test meal is significant of ulceration even when no blood, pus, etc., are present. In latent ulcer, because of a slight degree of stagnation and the presence of crypts for the proliferation and lodgment of bacteria at the ulcer site, a greater than 2 per cent. of gas may be observed. In alimentary gastrosuccorrhœa, or gastrosuccorrhœa periodica, a negative gas result is noted from the test meals. But where the gastrosuccorrhœa is post-ulcer in nature (chronic hypersecretion) a greater than 2 per cent. gas result may be seen even with the presence of a highly acid stomach, making possible, in many of these cases, the diagnosis of post-ulcer hypersecretion and for which surgery offers the only hope of cure.

Gastric Carcinoma.—Clinically, these cases may be divided into those with and those without the normal stomach secretion. With those having acid-enzymotic secretion and a definite or

suggested history of ulcer, in whom test meals, constantly, intermittently, or never show the presence of blood, but which still give a greater than 2 per cent. of gas result with neutralized meal are most times operative in nature—the complete diagnosis of cancer being made at the time of operation or after that by the pathologist often to the surprise of all concerned in the case. It is as near perfect as is now possible to decree that a case is surgical in nature, and with the patient and surgeon take your chances that the harmless exploratory incision will dissipate the tentative diagnosis or raise the estimation of your opinion of yourself as a diagnostician in stomach disorders to a level which will last you as long as you live. With pyloric cancer having achylic stagnation, large amounts of Boas-Oppler bacilli in the stomach and feces and the constant presence of blood, the gas result, from the excessive carbohydrate fermentation, is high, running even up to 30 per cent. in signal cases, but usually above 2 per cent.

Kindly remember that I do not claim that every case of ulcer and cancer even under apparently ideal conditions gives gas results of value. In medicine, almost all laboratory tests are only of value when positive, and they do not necessarily make for other diagnoses when they are not. Further in significance, these tests are not to be looked upon in gastric cases to the exclusion of the history, examination of the patient, and the other well known details of test meal examination, or those of the just as important fasting stomach contents and generally employed feces tests.

Benign Pyloric Stenosis.—In these the proteids in the stomach may be split up by the bacteria

present and cause the generation of sulphurated hydrogen. Such test meals will show a gas result, the lead water in the second bottle turning darker as this bubbles through, and perhaps an alkalinity from ammonia in the first bottle. The decomposition in cancer stomachs is mostly a fermentation of the carbohydrate products, still, in some cancer cases, proteid putrefaction is present, so that in the distinction between the two types of pyloric stenosis, the presence of sulphurated hydrogen is only to be taken as suggestive of a benign condition.

Intestines.—Local disorders of digestion in the intestines, in my opinion, make up far more cases of affections of the digestive canal than those due only to local disorder in the stomach. In his work with Krehl, Cohnheim[1] studied the problem experimentally, and found, significantly, that it was almost impossible to produce functional derangements of the stomach by direct injuries to the organ itself. Using dogs which had been provided with both gastric and intestinal fistulæ, these investigators showed that injury to the intestine affected not only the functions of the intestines but also to a marked degree those of the stomach. They were able to prove that following an injection of magnesium sulphate (Epsom salts) into the intestine that the amount of stomach secretion at the succeeding meal was increased to nearly double, while after a similar injection of a strong solution of sodium chloride (table salt) the amount produced by the meal was less than one-half. Analagous changes were produced in the total acidity and in the length of time required to empty the stomach. As judged from many observations of feces tests and treat-

[1] Otto Cohnheim. Harvey Society Lecture, December 4, 1909.

ment for these conditions in cases of chronic intestinal putrefactions, a constantly low running degree of toxæmia from the bowel can be shown to have an etiological bearing upon many of the cases of disturbed sensation, secretion and motility of the stomach, and, contrary to what our sense impressions have taught us, we must seek the origin of many gastric disturbances in the intestine, rather than consider them as only gastric affections or neurotic ones referred from parts other than the digestive canal. In the discussion of a paper on indicanuria at the annual meeting of the American Medical Association last June, I pointed out that, contrary to the general teaching, a marked type of indolic putrefaction may and often does exist with a high stomach secretion and motility. In my records of 127 cases of indolic putrefaction, 79 showed a hyper, or normal acid secretion, and in the 48 in which this was below normal or absent, 34 subsequently gave evidence of improvement in the stomach secretions when the bowel conditions became improved. Thus in gastric work the feces test for bacteria should never be omitted. Indicanuric conditions (which as a clinical entity is no more significant to me than œdema or cough would be), must be looked upon both as an aggravator and depressor of stomach secretion, and the stomach conditions mentioned are not to be considered as neurotic in nature unless the bacteriological feces examinations are negative. For the basis of these intestinal conditions the most useful clinical classification is that of Herter,[1] namely, the indolic, saccharo-butyric, and the combined forms. Considering that from the

[1] Herter. Bacterial Infections of the Digestive Tract.

bowel a normal individual voids about 126 billions of bacteria a day of many different types and that the performing of culture methods for segregation are almost impossible for clinical work, the apparatus method answers well and to better clinical purpose for diagnosis than a simple Gram differential stain of the raw feces. Fortunately, there are three main anærobes prominently found in all of these cases, and each of these grow well in the closed limb and on the media mentioned. They are the bacillus coli communis to note the indolic form, and the bacillus ærogenes capsulatus and the gram positive diplococci to note the saccharo-butyric form, and thus when any of these bacteria grow in wild and predominant proliferation in the media the diagnosis and therapeutics in the case are suggested.

General Remarks and Normal Standards.

In healthy man, the natural secretions of the intestine with the defecations hold the bacterial content down. Under ordinary conditions there are few colon bacilli in normal feces. Most of the bacteria are present in the colon, where the anærobic conditions for their proliferation are perfect. The putrefactive processes are due mostly to the anærobes. As a rule, a patient on a meat diet, harbors less organisms, and thus less gas, than those on a mixed or carbohydrate diet, but this need only be considered in a relative way in the bacterial tests. Indol from putrefaction of the proteids is not due to tryptic digestion, but to bacteria, and mostly to the bacillus of the coli group and not the bacillus ærogenes capsulatus or G. P. diplococci. As the liver and renal cells, if normal, produce enough oxydase to bind the

indol but very small amounts of indol appear in the urine. But if the supply of indol be great, or the liver and kidney function be deficient, larger amounts of indol are supplied to these organs and, being unbound, appears in the urine, and then the irritating effects on these organs, as well as other structures in the body, are produced.

Human bacillus coli communis have practically no power to dissolve and peptonize native proteins, but when these are first affected by the other organisms, the colon bacilli are able to energetically cleave the peptones and give rise to ammonia, volatile fatty acids, phenol, indol and hydrogen sulphide. The bacillus ærogenes capsulatus is a most abundant gas-making organism in dextrose bouillon cultures and generates hydrogen, carbon dioxide and butyric acid. Therefore, because of the mixed association of these and other influencing bacteria in the gut, the gas result from nutritive media in a general way must not be considered as too clinically distinctive. Nevertheless, as paradoxical as it seems, in the true cases of the saccarho-butyric type of chronic excessive intestinal putrefaction the gas result is generally low, usually only from 5 to 13 per cent., whereas in the indolic form this may run as high as 80 per cent. The normal standard I employ is that of gas from 20 to 30 per cent. It should be recalled that in a normal individual with the feces and water suspension, a meat diet gives a lower gas than the ordinary diet, and a vegetable higher than the ordinary, while in the states of chronic excessive intestinal putrefaction, the indolic type (due mostly to bacteria proteid cleavers) gives a higher than normal, and in the saccharo-butyric type (mostly

bacteria carbohydrate cleavers) a lower than normal. Therefore, a patient whose feces gives a higher than normal gas result in nutritive media should be placed upon a strict meat diet and the watery suspension feces test performed, and if in this the gas is higher than the meat diet should normally be, the diagnosis of the indolic form is suggested; and to reverse the method, when the gas result in the nutritive media is less than normal, the patient should be placed upon a strict carbohydrate diet to see if the gas from watery suspension of feces still remains below what is ordinarily seen in an individual on a strict carbohydrate diet, at which, when positive, the diagnosis of the saccharo-butyric form is suggested.

But to arrive at these diagnoses to a more conclusive extent the urine must also be examined for the different substances, and also the bacteria grown in the nutritive dextrose bouillon stained and examined. In the indolic and combined form, indol in large amounts is present in the urine; in the combined to the least extent, but none at all in the true saccharo-butyric form, in which uroresine (Jaffé test), large amounts of oxaluric acid crystals and phosphates are more commonly seen. With the Gram differential staining method the bacilli of coli group, being Gram-negative, are stained with the counter stain (red with carbol-fuchin), and the bacillus ærogenous capsulatus and diplococci, both Gram-positive, staining violet with the gentian violet; the distinction of colors serves well to differentiate them. The organisms of colon group are very small, the bacillus ærogenous capsulatus very large, like thick rods, and the Gram-negative diplococci are also quite large and easily distin-

guished. In both types of putrefaction these organisms are found in the closed limb of the apparatus and easily observed.

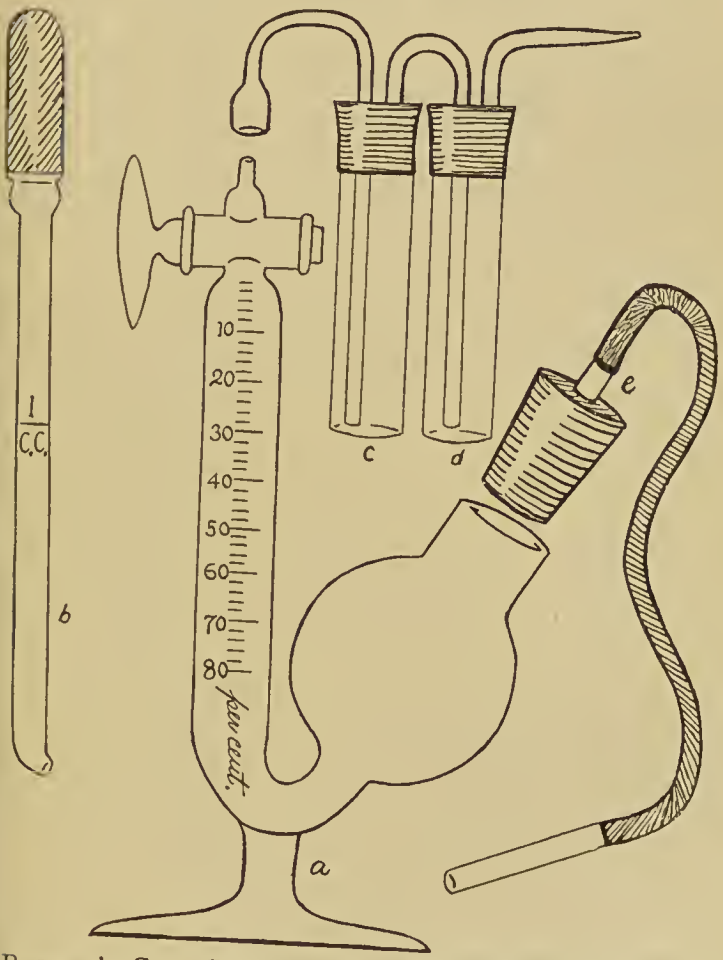
Types of Chronic Excessive Intestinal Putrefaction.

Saccharo-Butyric Type.—This is a most common affection, widespread among children and adults, and the most common of the three types. According to the degree of the condition and length of time it has existed, symptoms develop and these may be expressed in the clinical conditions called intestinal indigestion, irritability of the intestines, the various secretory, motor and sensory disturbances of the stomach, intolerance to taking sugars and starches, fats and acids, obscure anæmias, debility, loss of weight, diminution of muscular power, premature senility, loss of sexual power, and in children, chronic state of subnutrition and tardy development and lack of resistance against acute infectious diseases, and, in both the adult and child, special liability to catarrhal affections, particularly those of the upper respiratory tract. It is probable that this and the other types will some day be proved to be the etiology of many of the to-day disease of obscure origin.

Combined Indolic and Saccharo-Butyric Type.—This is the next common form, and among the clinical conditions seen may be mentioned psychic disturbances in the emotional sphere of both the irritable and depressed forms, anæmia, loss of strength, weight, and ability to attend to ordinary business occupations without great effort, a chronic low state of body and then finally a pronounced invalidism from damage to the nervous system, insomnia, multiple neuritis, progressive

muscular atrophy, perhaps pernicious anæmia and more probably the pseudo form, and most often various forms of disturbances in gastric digestion.

Indolic Type—This is the least common form,



Bassler's Gas, Chemical and Bacteriological Apparatus for the Examination of Gastric Contents and Feces.

and is seen in the marantic, large-belly type of chronic intestinal indigestion on children who later show myasthenia and retardation of growth; and in the adult, in the neurasthenic, debilitated type of individual in whom "a chronic indicanuria" is sufficient enough diagnosis to stamp him as a worrisome patient on our hands for long periods of time. Among these poor unfortunates are seen the symptoms of obstinate constipation, headaches, mental confusion, catarrhal affections of the respiratory tract, gastric and intestinal atony and all of the functional disturbances, prolapse of the viscera, chronic invalidism and inability to stand work or mental strain, anæmia and subnutrition, and lastly and most important of all, a number of the intractable cases of the great American disease—neurasthenia.

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